



Integrating Runoff Processes Across Scale in a Subarctic Catchment

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Outline



- Brief Overview of Wolf Creek Research Basin and Previous Research
- Background and Scientific Objectives
- Research to Date
- Future Program



The Wolf Creek Research Basin



Location:

60°31 N, 135° 31' W

Area:

Approx. 200 km²

Elevation Range:

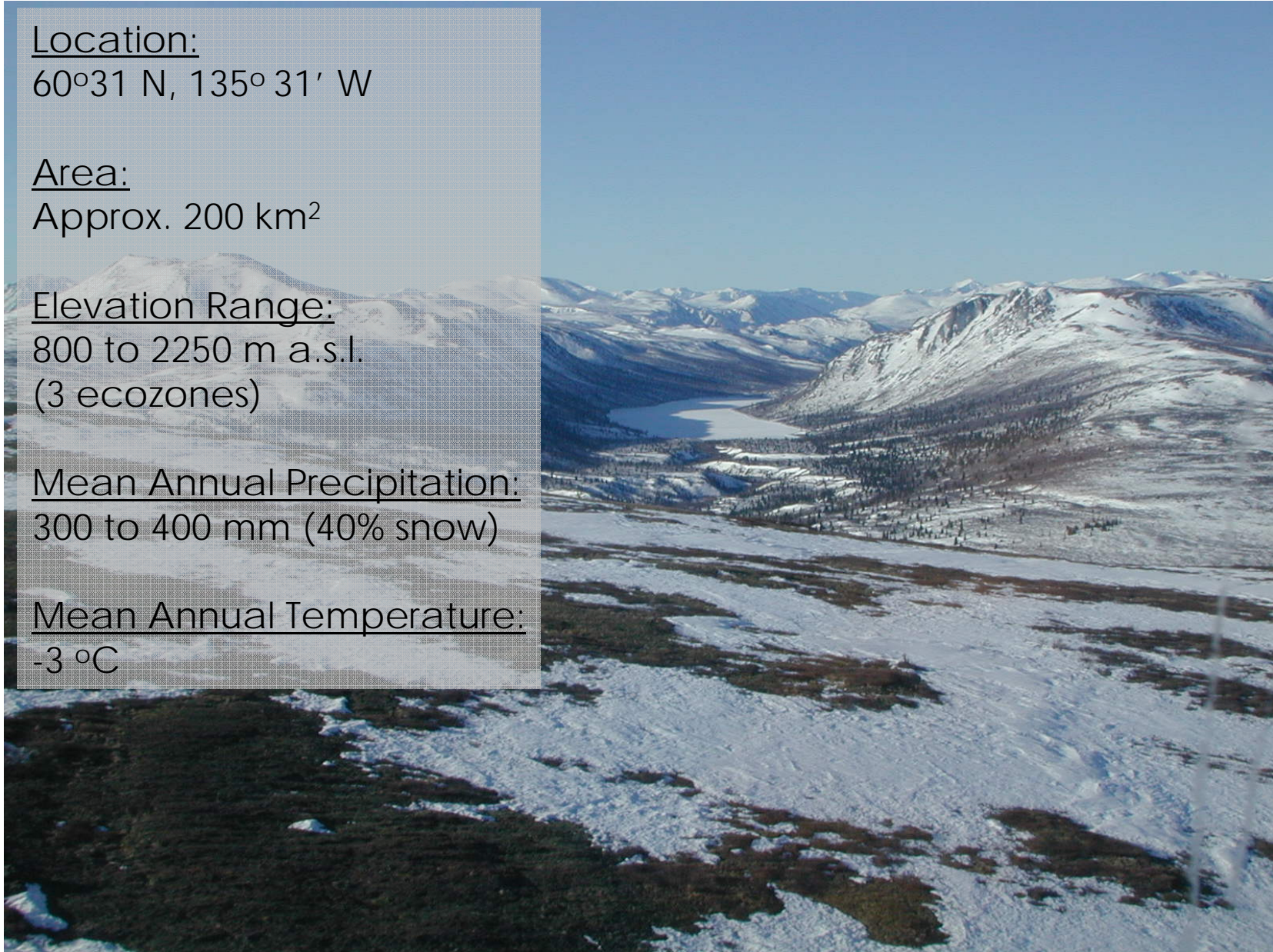
800 to 2250 m a.s.l.
(3 ecozones)

Mean Annual Precipitation:

300 to 400 mm (40% snow)

Mean Annual Temperature:

-3 °C





Previous Research



Seasonally Frozen Soils
- well drained



Permafrost Soils
-capping organic layer
-Relatively impermeable base





Influence of permafrost on runoff processes

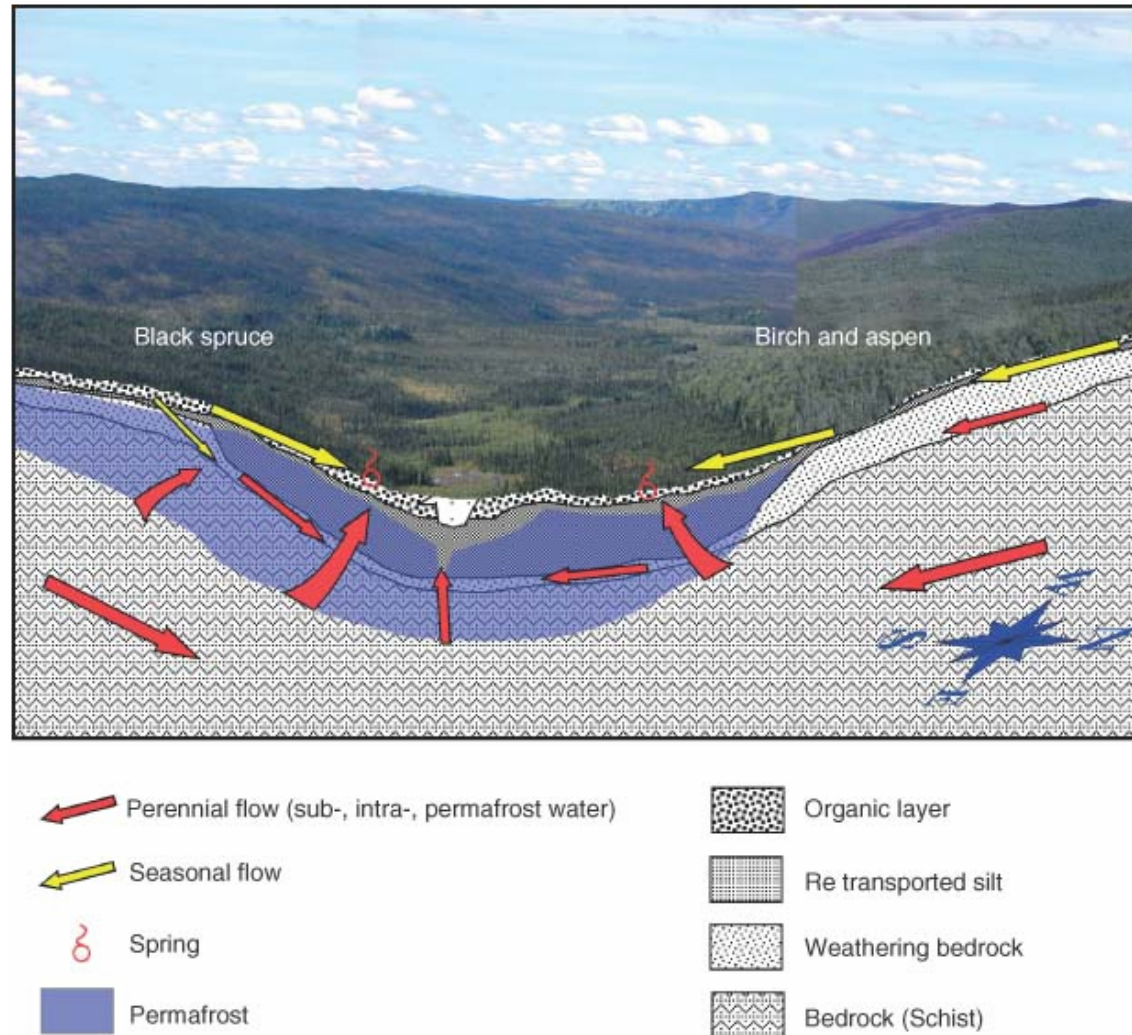
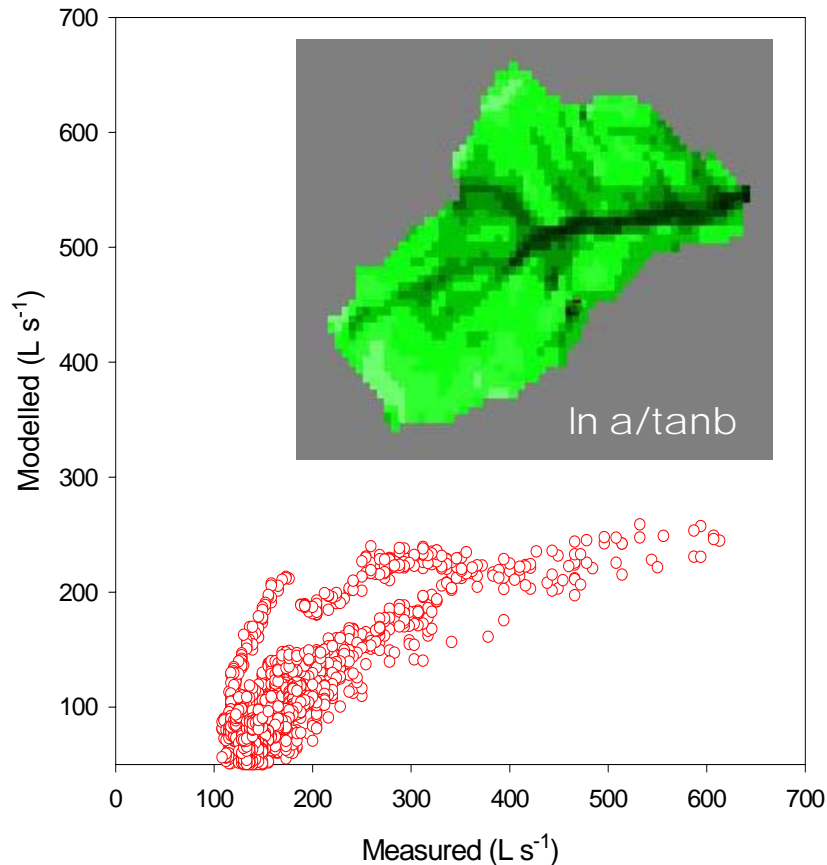


Figure Source: Encyclopedia of Hydrological Sciences, John Wiley & Sons, Ltd.



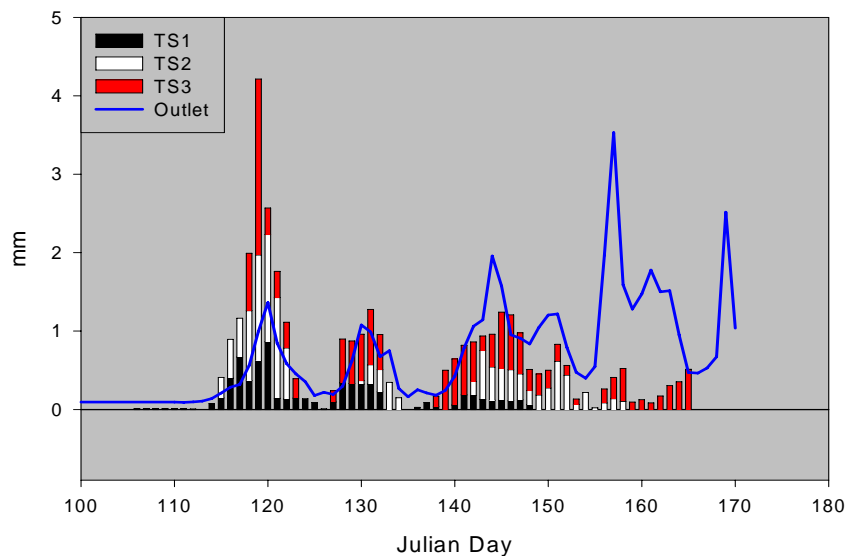
Topography alone does not control runoff response



- In the alpine subarctic, topography is not the key element controlling the position of the water table and contributing areas as in temperate regions



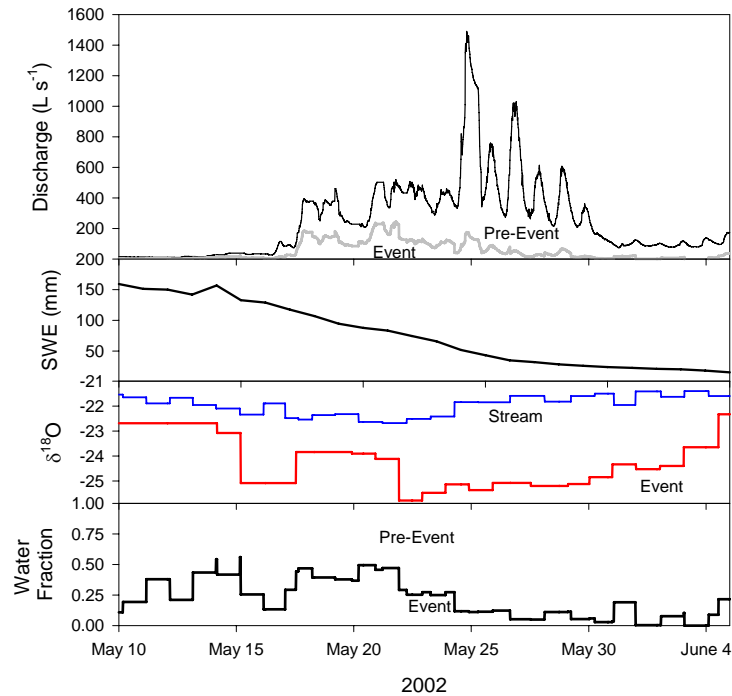
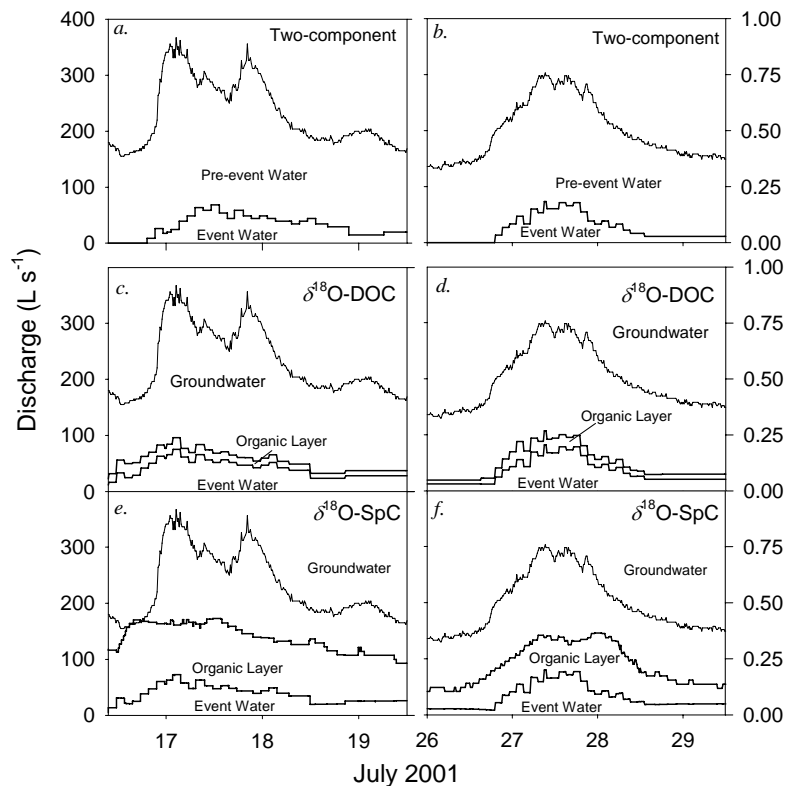
Runoff is strongly influenced by ecozones



- Certain ecosystems are more capable of trapping snow, enhancing runoff production and developing a soil profile capable of conveying water rapidly to the stream
- Tall shrubs have a particular efficacy in trapping snow and generating runoff



Deep subsurface groundwater is important



- Intra and sub-permafrost groundwater contributions are poorly characterized
- New results highlight the importance of this water in discontinuous permafrost catchments



IP3 Objectives – Carey Theme 1



- Determine how connectivity in the drainage network controls streamflow response at the Hydrological Response Unit scale
- Improve understanding of frozen soil infiltration and hydraulic properties

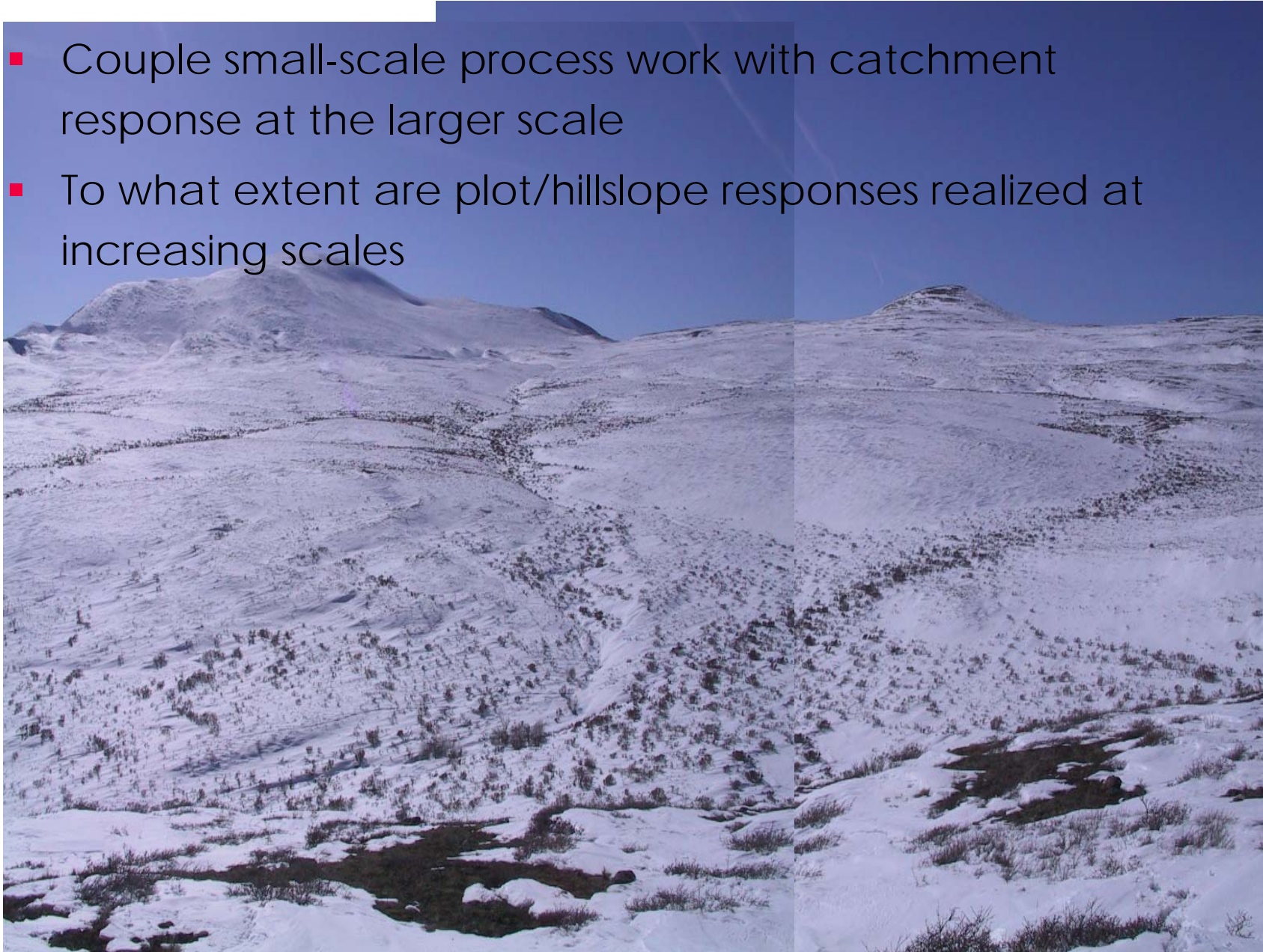




Research Approach



- Couple small-scale process work with catchment response at the larger scale
- To what extent are plot/hillslope responses realized at increasing scales

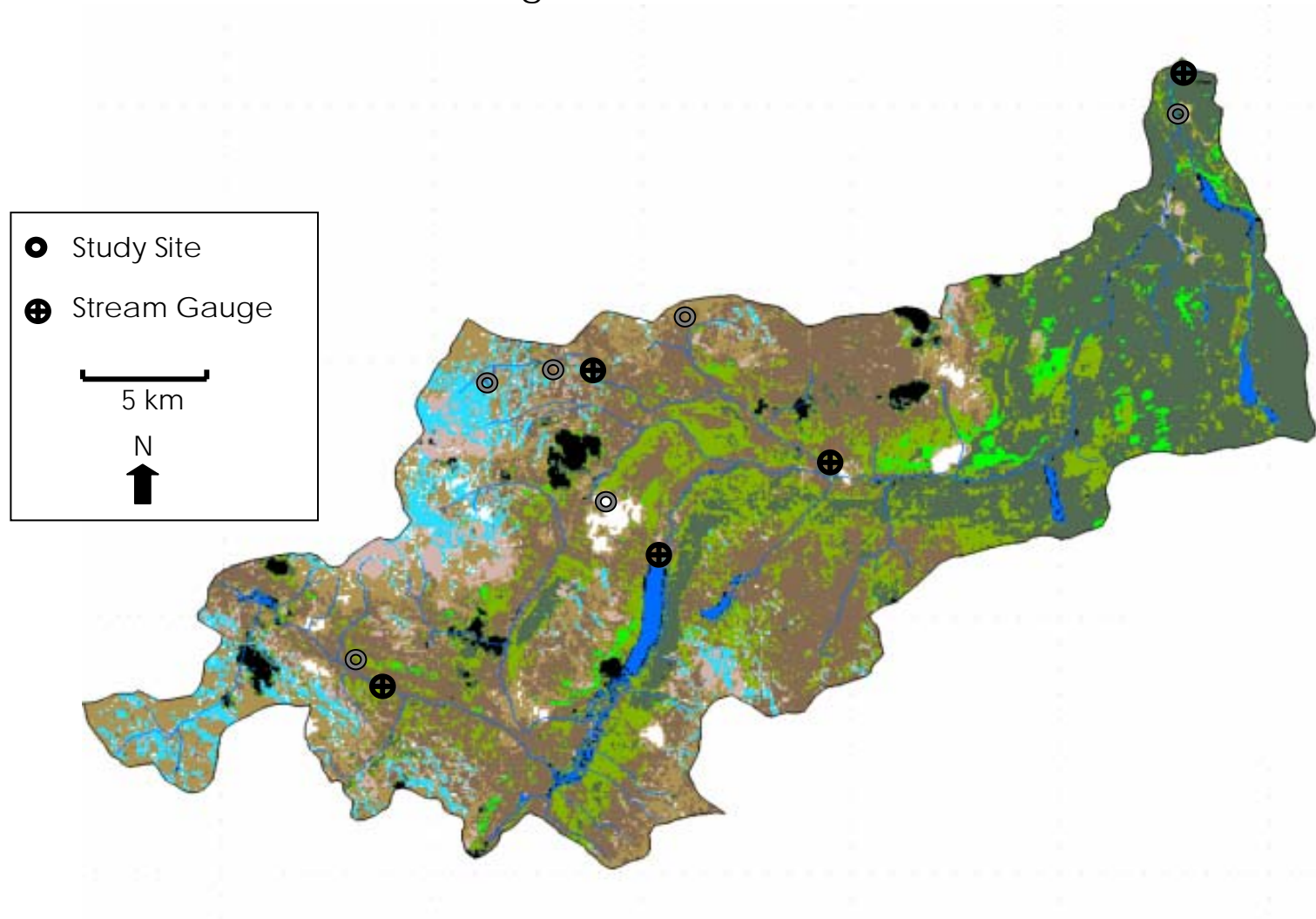




Research Approach



- Nested watersheds among ecozones

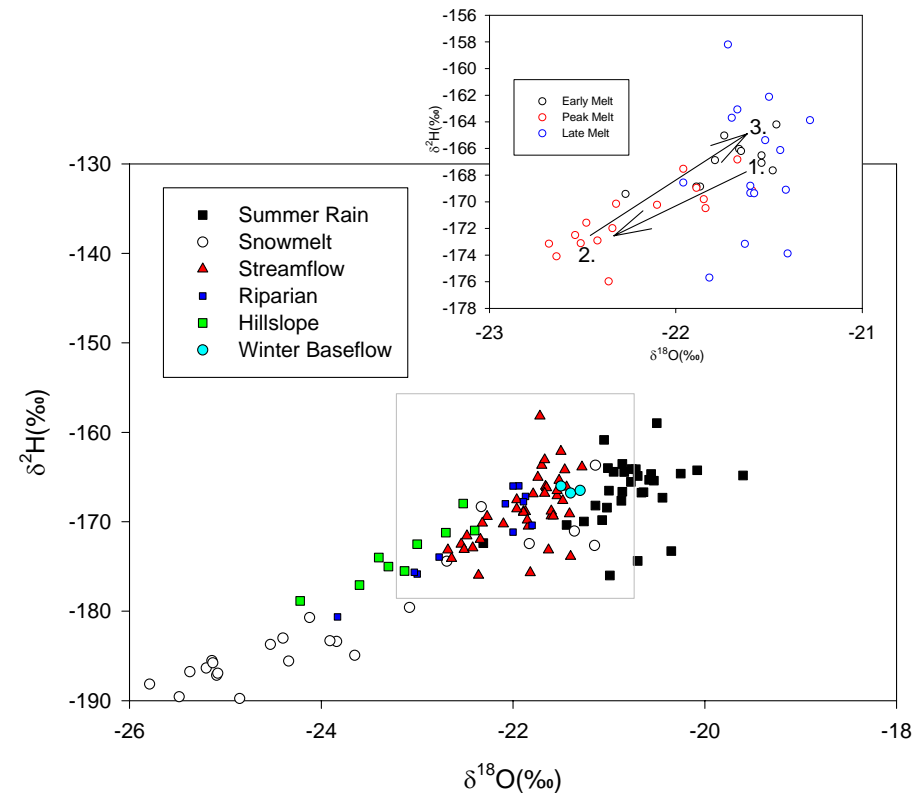
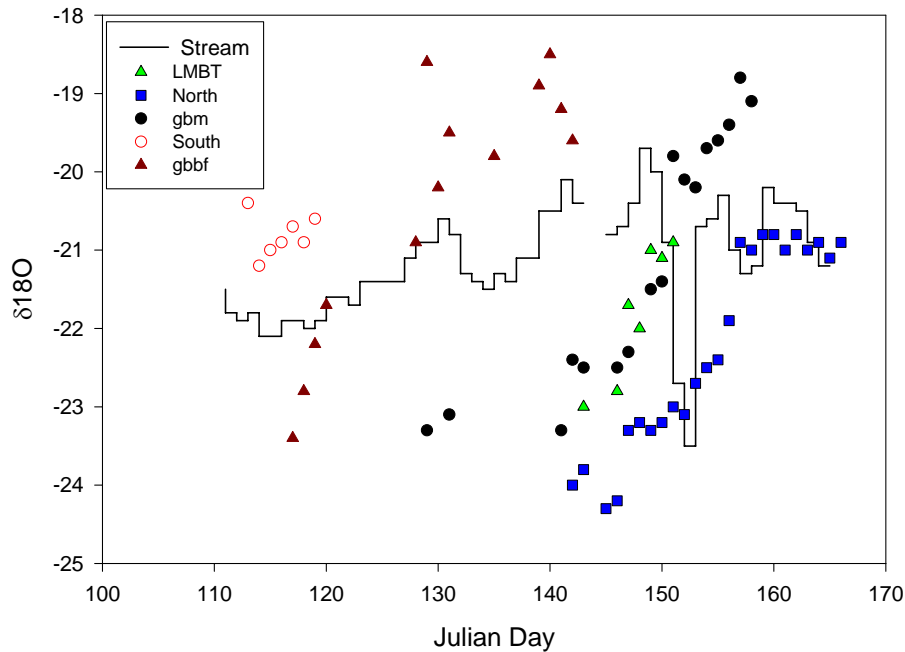




Research Approach



- Major ion chemistry and stable isotopes will be combined with distributed runoff data to evaluate the role of different ecozones, topology and channel processes on streamflow generation.





Research Approach



- Mapping hydrochemistry to evaluate source areas

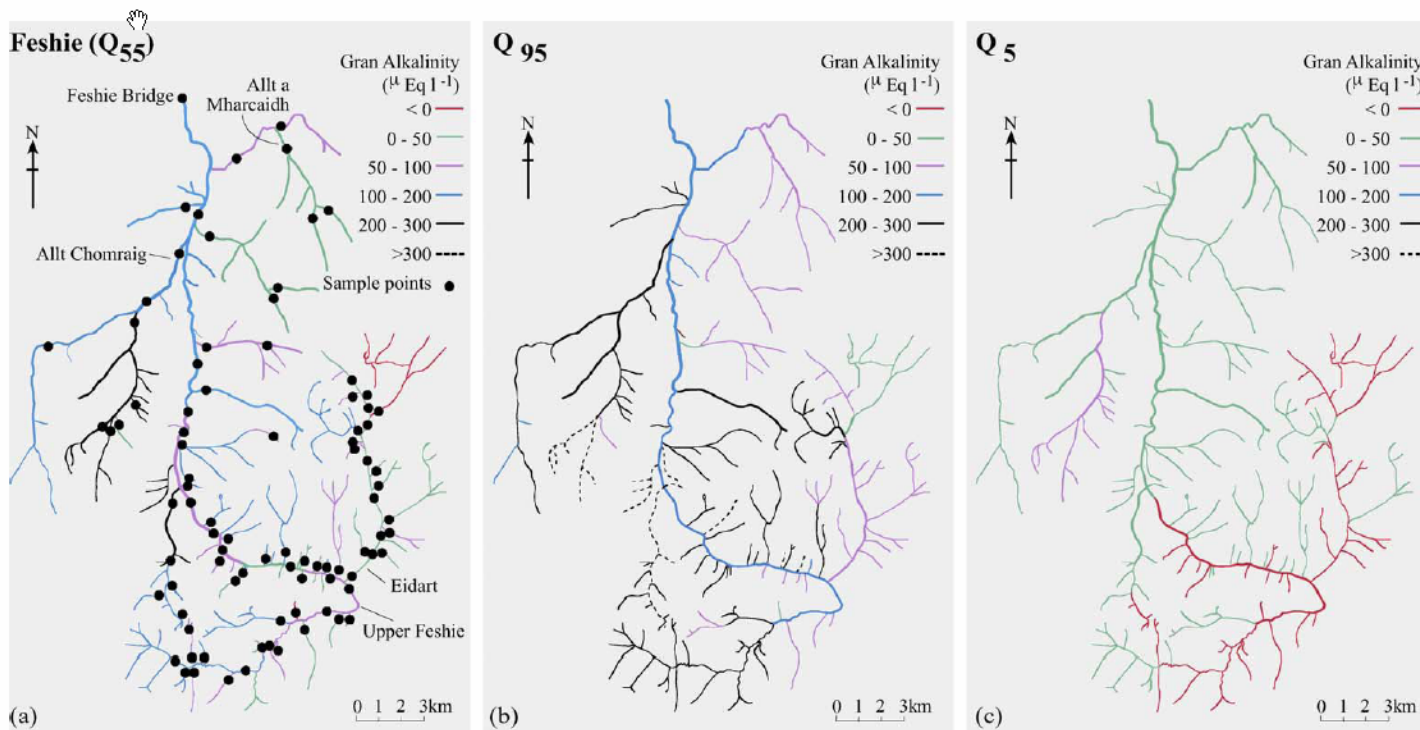


Fig. 7. Spatial variation in Gran alkalinity in the Feshie catchment (a) May 2002, (b) Q_{95} , (c) Q_5 .

C. Soulsby et al. / Journal of Hydrology 291 (2004) 174–196

Celina Ziegler – MSc (ion analysis conducted this week)

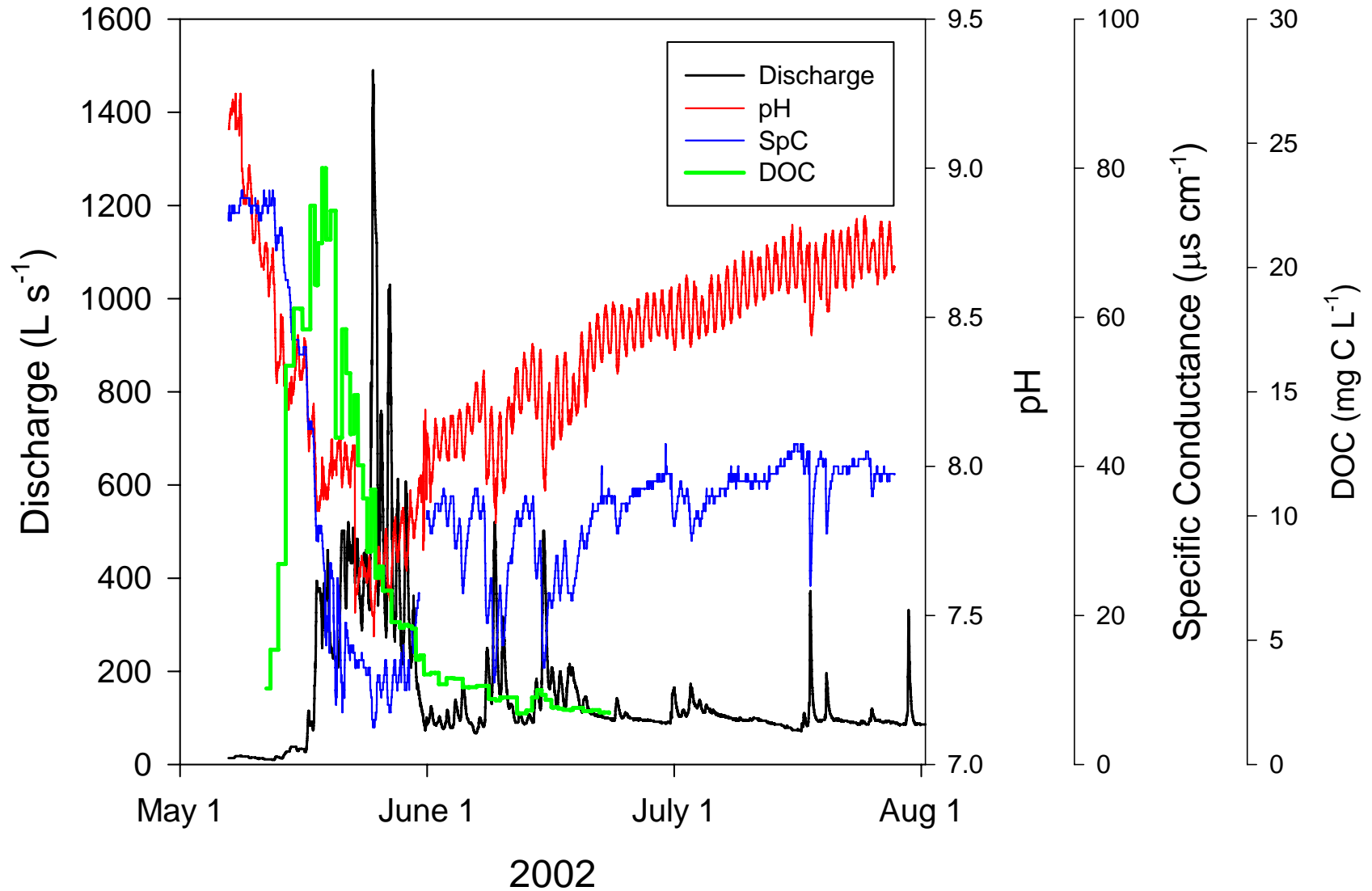




Research Approach

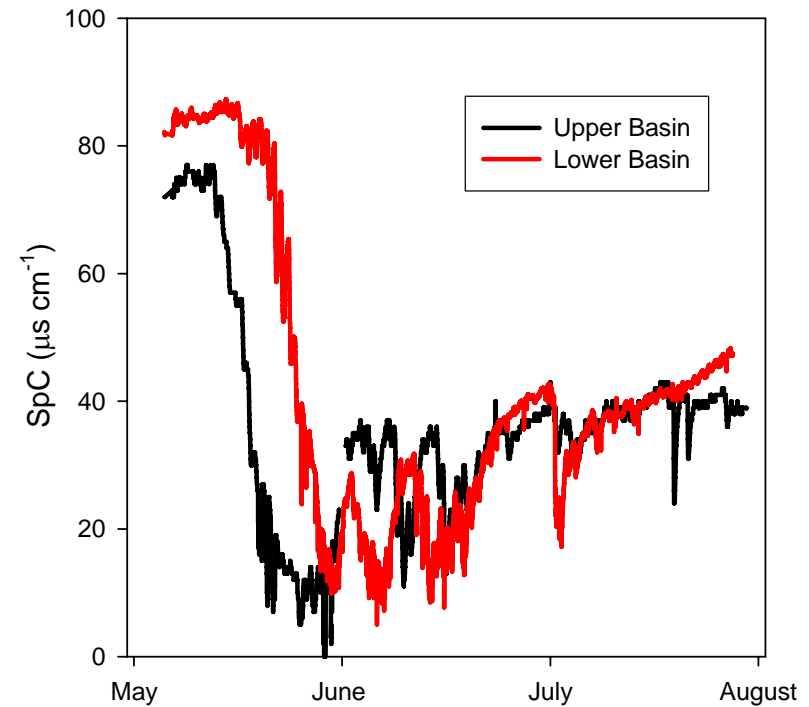
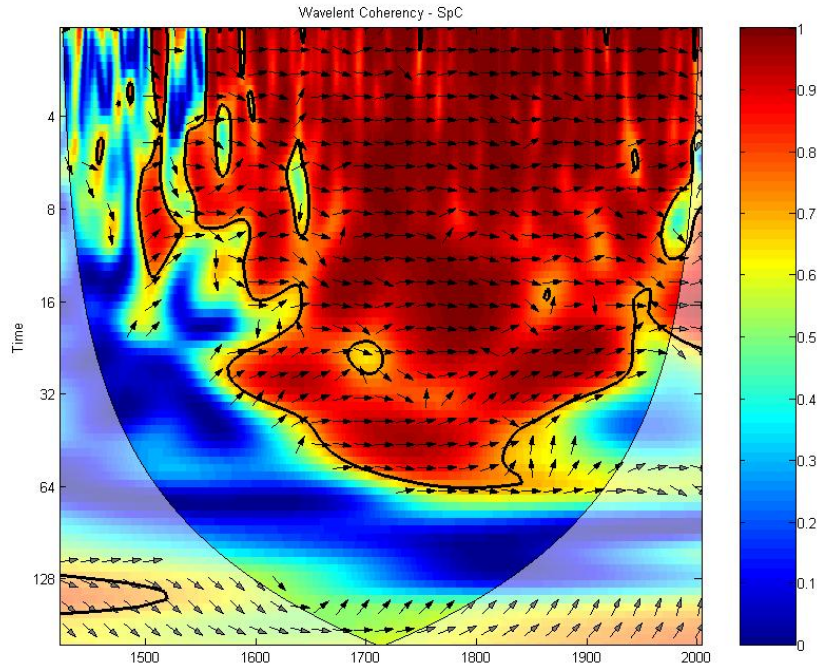


- High-frequency water quality data as a way forward





Research Approach



- Utilize high-frequency data with time-series analysis to provide new light on basin-wide hydrological controls



Research Approach – Organic Soils



- Field and Laboratory studies of organic soil properties
 - Frozen and thawed soil infiltration/percolation studies
 - (tracer/TDR)
 - Pressure plate analysis
 - Image analysis (Quinton)
 - Air permeameter experiments





IP3 Objectives - Carey Theme 2



- Develop basin parameterization strategies to represent HRU processes and interactions
 - Dr. Yinsuo Zhang

